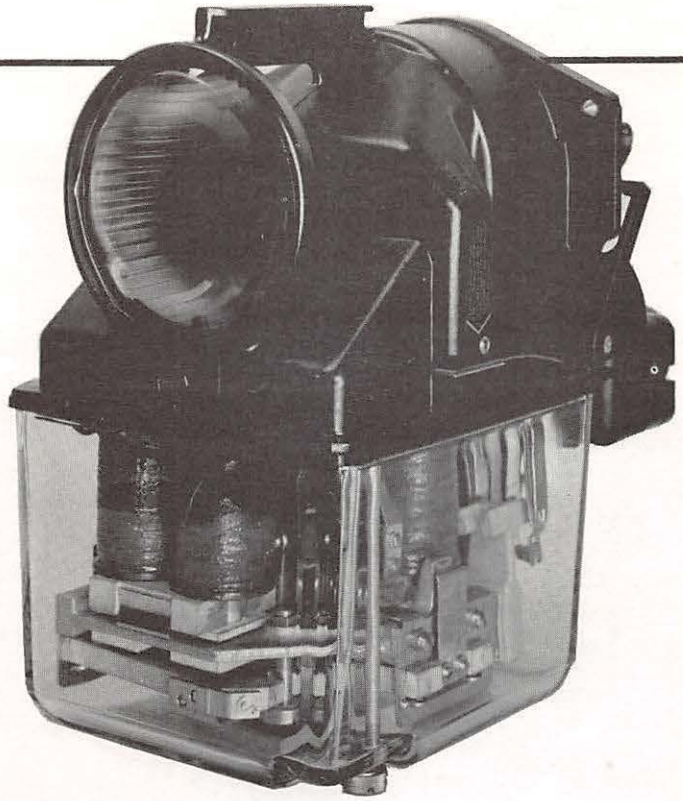


GRS TYPE SD
SEARCHLIGHT SIGNAL

GENERAL RAILWAY SIGNAL COMPANY
ROCHESTER 2, NEW YORK

MARCH 1959

D50. 0201

PRINTED IN U.S.A.

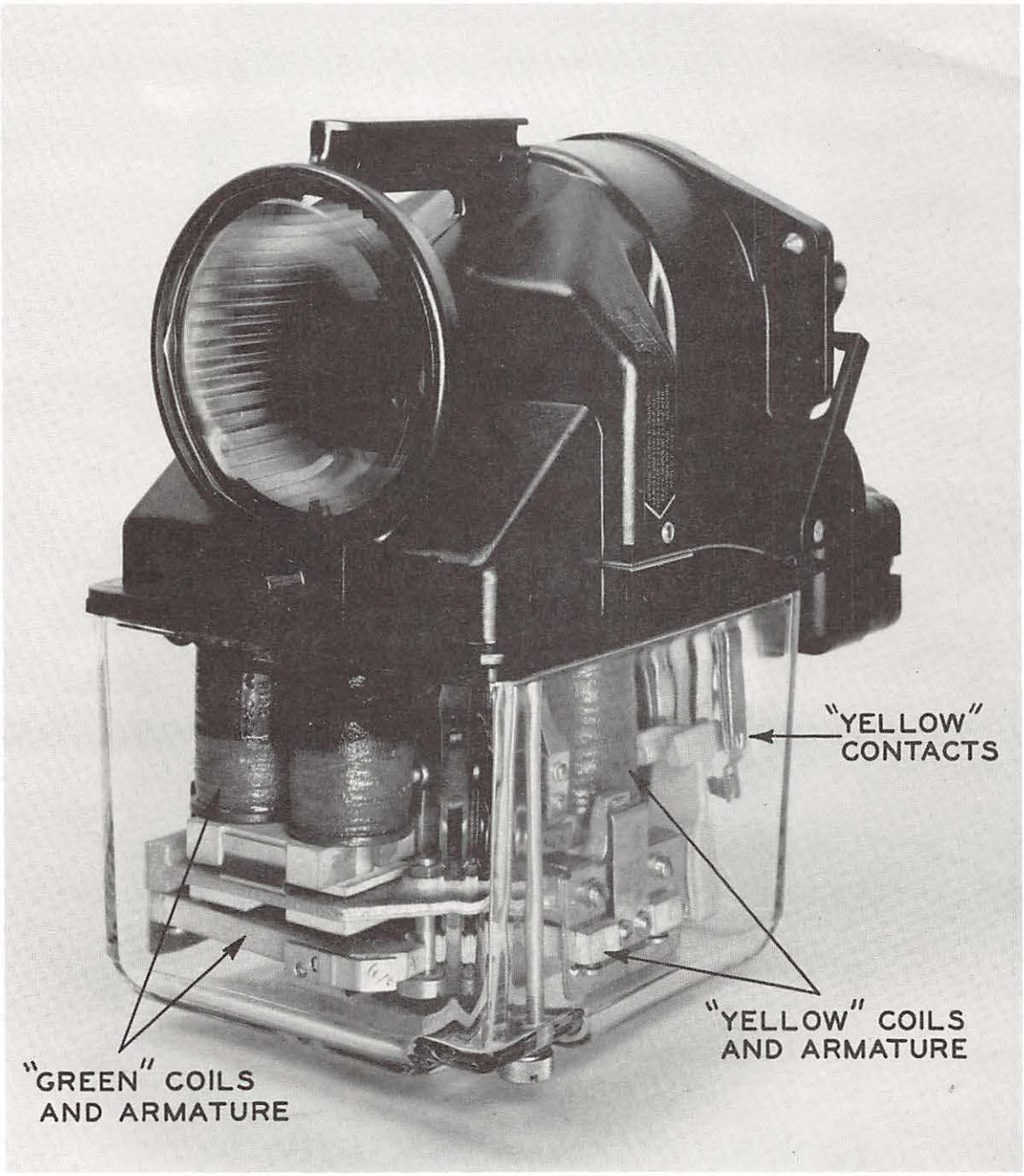


Figure 1. Type SD signal operating mechanism.

A CHECK LIST OF SD SIGNAL FEATURES

- Simple, time-proven, tractive-armature drive.
- Dual tractive-armature structure, --- two independent armatures, each operating its own set of contacts.
- Aspect-checking contacts directly operated by tractive armatures.
- Service-proven, shunt-protected, biased-neutral operation.
- Positive spectacle positioning and color indication.
- Built-in resilient mounting of signal movement.
- All color discs slanted to minimize beam dilution.
- Choice of compound lens or stepped lens optical system.
- Choice of deflecting or Spredlite roundel. Phankill unit available.
- Precision filament lamps -- no refocusing needed.
- Plug-in adjustable lamp resistor: one, two or five ohms.
- Plug-coupled connections.
- Built-in sighting fixture, screened vents, easy-latch door, ample wiring space.
- Mechanically, electrically, and optically interchangeable with Type SA signal. Same size and weight, with improved operating values. Same outer housing.

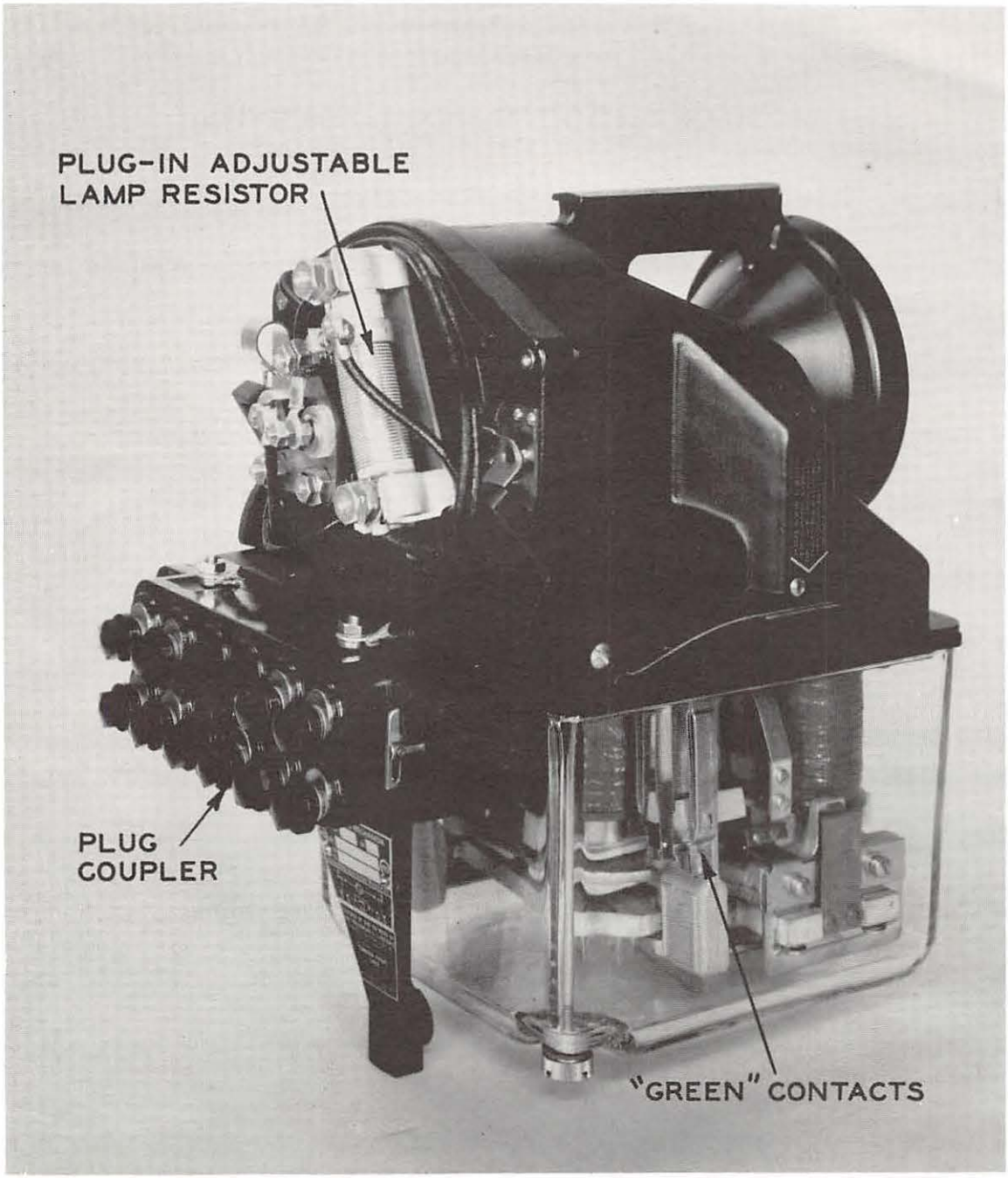


Figure 2. Type SD signal operating mechanism, rear view.

TYPE SD SIGNAL

The Type SD signal is a color-light signal of the searchlight type. This signal was developed to incorporate in one searchlight signal the outstanding advantages of the Types SA and SC signals, together with other improvements. The SD signal uses the tractive-armature principle of the SC mechanism in a signal of the same physical size and weight as the SA. The operating mechanism uses two biased-neutral tractive-armature elements connected in multiple.

The Type SD mechanism, Figures 1-3, fits the Type SA housings now being supplied. Older Type SA housings require minor alteration (as specified in Change Notification Sheet A-802-34) to accommodate the Type SD mechanism.

Figure 3 shows the SD signal mechanism with the lamp and reflector unit removed. The reflector holder features a plug-in type, adjustable, lamp resistor, which makes it easy to change the resistor to match the lamp you plan to use. Resistors are available in three different resistances: one ohm, two ohms, and five ohms. All color discs are slanted in the spectacle to deflect any extraneous light upward and out of the optical system to the serrated black cone, where it is absorbed. The removable half of the plug coupler shows an air-gap lightning arrester which provides a path from case to control wires for surges in excess of 2000 volts. The lightning arrester bypasses the tractive-armature movement coils, which are insulated to withstand 5000 volts to ground.

The SD mechanism is built upon a forged silicon-steel yoke plate which is supported at both top and bottom by vibration-absorbing springs. Tractive-armature movement coils, cores, armatures, spectacle arm, contacts, and current-blocking half-wave rectifiers are all mounted on this rigid yoke plate.

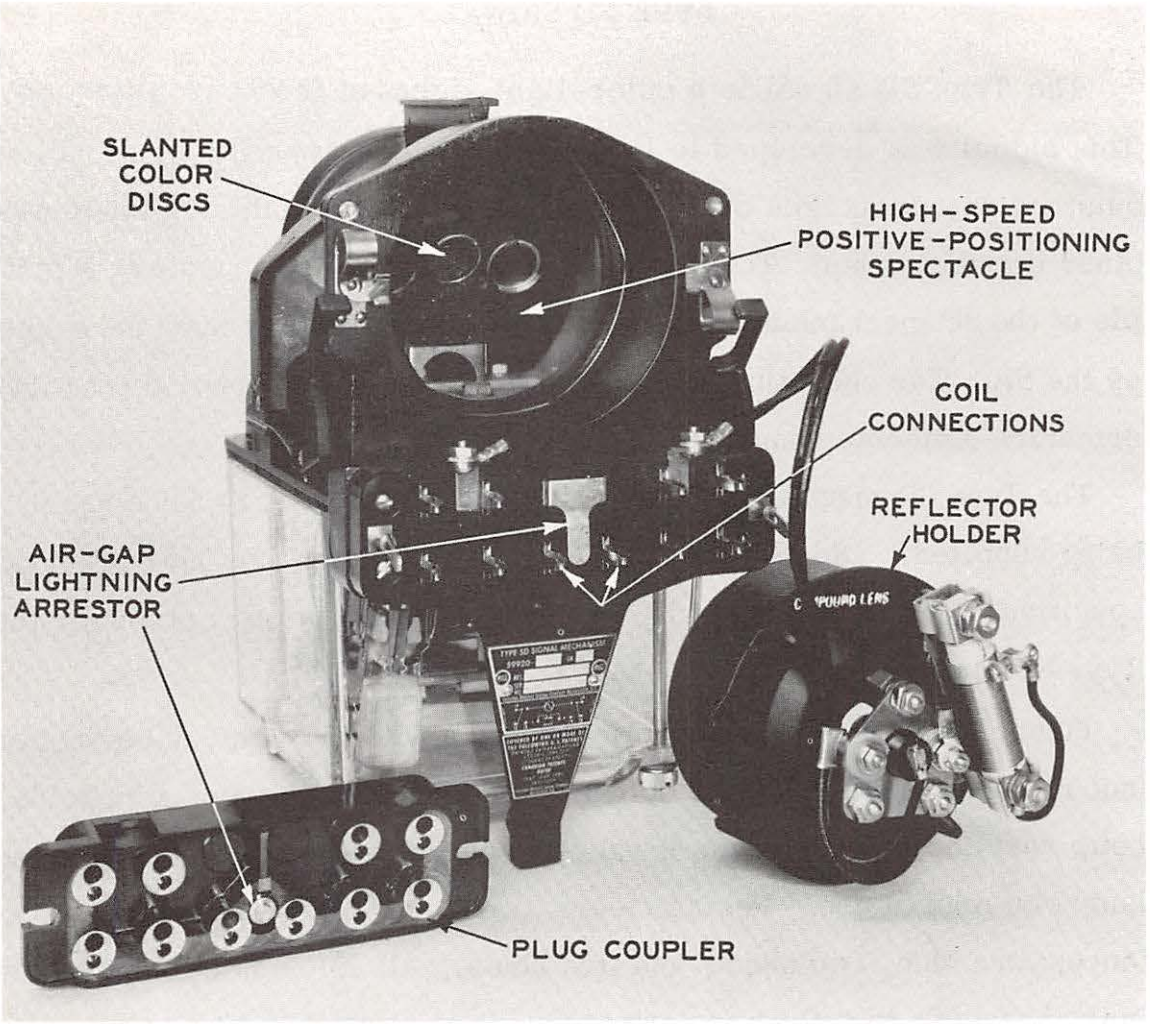


Figure 3. With reflector holder removed, the slanted color discs can be seen within the mechanism.

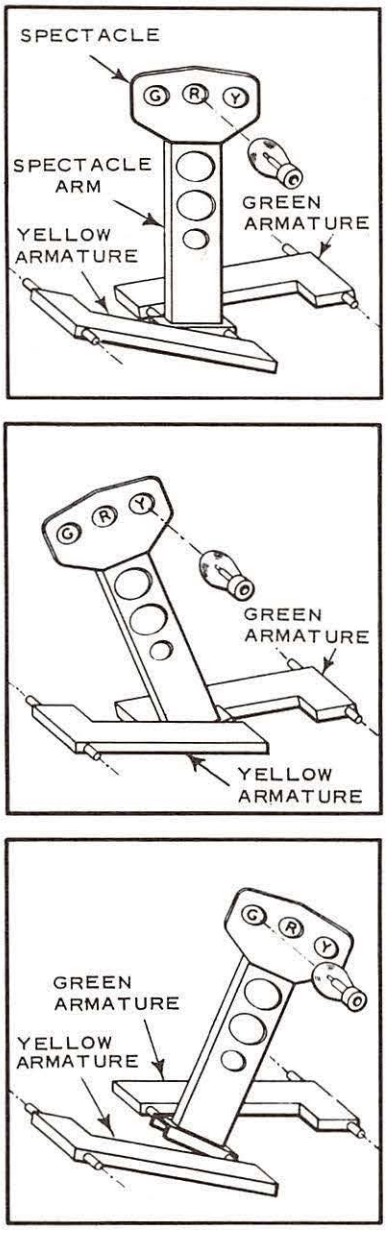
Operation, Mechanical and Electrical

Figure 4 shows the mechanical principles of operation.

Figure 5 shows electrical operation and contact positions. Magnetic structure of the mechanism-operating tractive-armature movements is the same as a GRS biased-neutral relay — a core-yoke structure shunted with a permanent magnet (actually two Alnico magnets across each pair of pole pieces) and a leakage strip. Half-wave rectifiers shown are germanium diodes. They have no safety function, serving only to reduce

energy required by blocking current flow through the tractive-armature movement not "used". Putting the rectifier between the coils utilizes the coil inductive reactance to protect the rectifier against lightning surges.

Normally, as you can see by the flux pattern in Figure 5a, the major part of the flux from the permanent magnets flows through the cores and



BOTH ARMATURES DOWN. SPECTACLE ARM POSITIONS RED COLOR DISC IN CENTER OF LIGHT BEAM.

YELLOW ARMATURE PICKED UP - GREEN ARMATURE DOWN. SPECTACLE ARM POSITIONS YELLOW COLOR DISC IN CENTER OF LIGHT BEAM.

GREEN ARMATURE PICKED UP - YELLOW ARMATURE DOWN. SPECTACLE ARM POSITIONS GREEN COLOR DISC IN CENTER OF LIGHT BEAM.

Figure 4. Simplified diagram showing spectacle drive principle.

GRS DEVELOPMENT SHEET

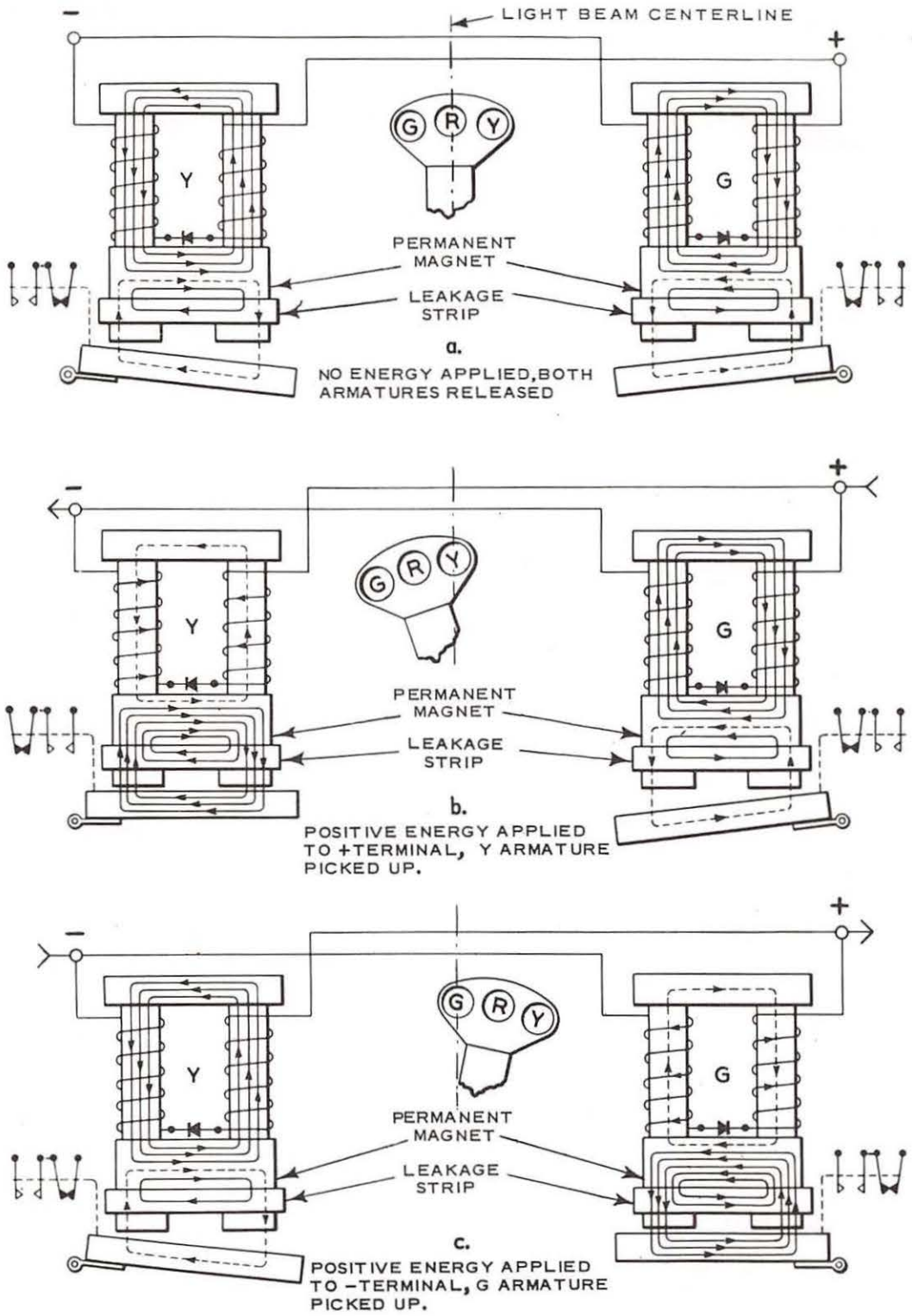


Figure 5. Simplified diagram showing electrical operation and contact positions.

yokes, the path of least magnetic reluctance. Both armatures are down because they carry only a few stray lines of flux.

In Figure 5b, current flows through the Y (Yellow) coils but is blocked from the G (Green) coils by the rectifier. Current flow in the Y coils is in a direction to induce flux which opposes the permanent magnet flux. Thus the Y core-yoke path now offers higher magnetic reluctance to the permanent magnet flux than does the path through the armature. The permanent magnet flux is in effect diverted to the armature, and the armature picks up.

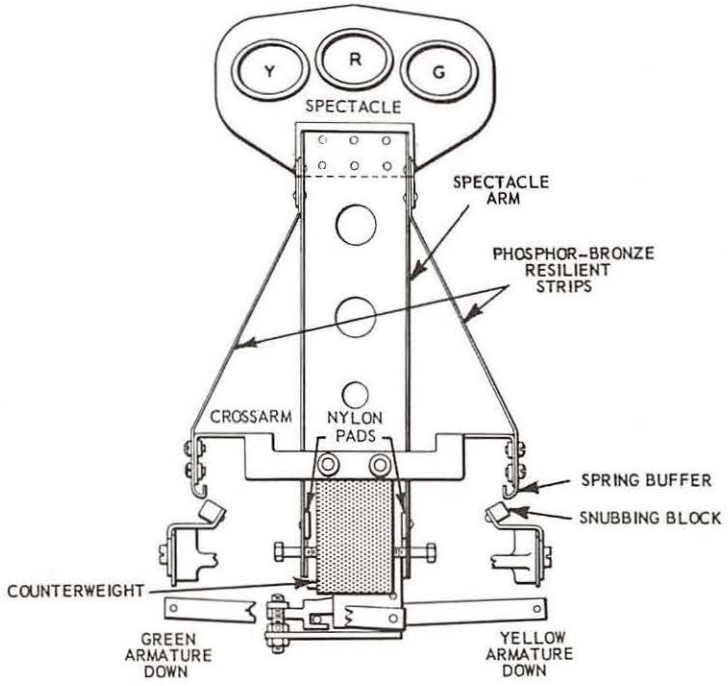
Figure 5c illustrates the same principle — with current reversed, the G armature picks up.

What happens if a rectifier breaks down, and current flows through both coils at once? Let's assume this happens to the rectifier on the G tractive-armature movement, for example, with polarity as in Figure 5b. The Y armature will, of course, pick up, and the spectacle will go to the yellow position — exactly as intended with such polarity. But the current now flowing in the G coils is in a direction to induce flux in the cores in the same direction as the permanent magnet flux already there. Thus the permanent magnet flux is not diverted to the armature, and the armature remains down. You can increase the current till the coils burn, but the G armature will not pick up.

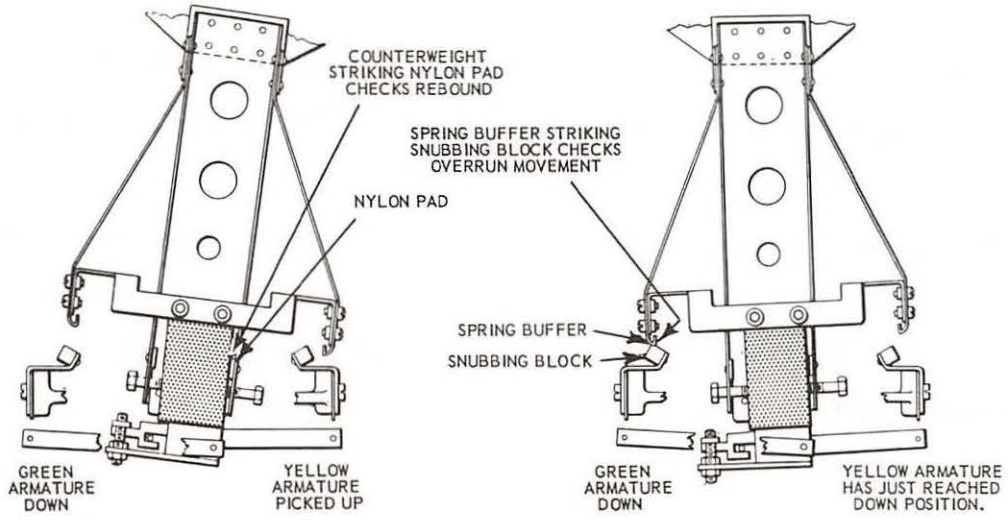
What if the permanent magnet should become demagnetized? First, it should be stated that this is very unlikely. The Alnico magnets used have great retentivity. In addition, they are purposely reduced, or "knocked down", from their maximum magnetization to ensure stability in service.

But let us assume the magnet does go dead. To see what would happen, let us first consider the function of the leakage strip. Normally, being across the cores and right next to the permanent magnet, it passively

accepts the flux of the permanent magnet and is, in effect, a part of it. But if the permanent magnet should lose its magnetism, the leakage strip would become a low-reluctance shunt across the cores. Turn on the coil current, and the induced flux would find a closed path of low reluctance,



a. Front view of spectacle arm.


COUNTERWEIGHT STRIKING NYLON PAD CHECKS REBOUND
NYLON PAD
GREEN ARMATURE DOWN
YELLOW ARMATURE PICKED UP
SPRING BUFFER STRIKING SNUBBING BLOCK CHECKS OVERRUN MOVEMENT
SPRING BUFFER
SNUBBING BLOCK
GREEN ARMATURE DOWN
YELLOW ARMATURE HAS JUST REACHED DOWN POSITION.

b. Damping action of counterweight when spectacle arm is operated to yellow position.

c. Damping action of spring buffer as spectacle arm returns to red position.

Figure 6. Pendulum-type counterweight prevents overrun or rebound.

through cores, leakage strip and yokes. The armature would present a path of too high reluctance to compete, so the armature would not be attracted to the pole pieces. If both Y and G magnets were dead, the spectacle would stay in the red position regardless of polarity of coil current. If only the Y magnet were dead, the signal would display the red aspect when energized for yellow, but would still be able to assume the green aspect when properly energized. The principle may be applied in like manner if the G magnet should fail. Energization for yellow would produce yellow; energization for green would result in red.

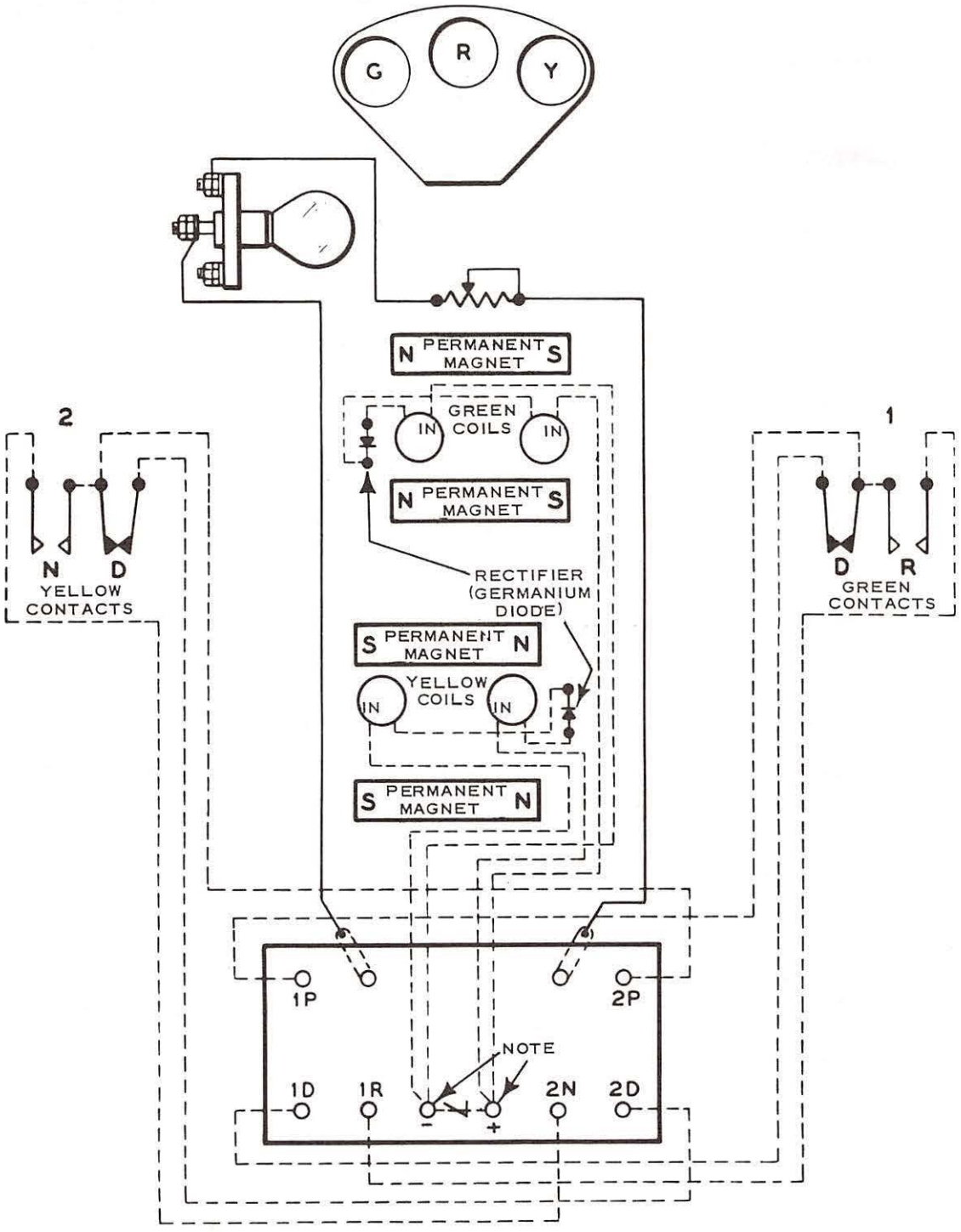
Pendulum-type Counterweight

When the signal operates, the spectacle arm moves rapidly from one position to the other. Ordinarily, this would cause an overrun when the spectacle arm returns to the center (red) position, or a rebound when the spectacle arm reaches either of its extreme positions (green or yellow). Any such overrun or rebound of the spectacle arm would be objectionable, since it would display momentarily the adjacent color aspect.

As shown in Figure 6, the spectacle arm is equipped with a pendulum-counterweight which eliminates overrun and rebound. The counterweight, Figure 6a, is attached to the crossarm, which is suspended from the top of the spectacle arm by two phosphor-bronze resilient strips. The counterweight normally hangs pendulum-fashion centrally between the sides of the channel-shaped spectacle arm. It is free, however, to move slightly to right or left against nylon pads when the arm is tilted.

When the spectacle arm is operated to either extreme position, as shown in Figure 6b, its movement is quite rapid and ahead of the counterweight. About the time the spectacle arm reaches its extreme position and tends to rebound, the counterweight swings over against the nylon pad on the side of the arm, arresting the rebound and causing the spectacle arm to settle back to its extreme position.

GRS DEVELOPMENT SHEET



NOTE: POSITIVE ENERGY ON + TERMINAL TO OPERATE TO YELLOW.
POSITIVE ENERGY ON - TERMINAL TO OPERATE TO GREEN.

Figure 7. Internal wiring of Type SD signal mechanism, as viewed from plugboard.

The ends of the phosphor-bronze resilient strips are carried down below the crossarm, where they are formed into spring buffers. These buffers come in contact with the fixed snubbing blocks during a movement of the spectacle arm from either extreme position to the center position, as shown in Figure 6c. The dropaway action of the armature being released is very rapid, causing a rapid movement of the spectacle arm. As a result, the momentum of the spectacle arm would tend to carry it slightly beyond its center position. But as the spectacle arm starts to move, the counterweight assembly remains momentarily against the nylon pad. This causes the spring buffer to strike the fixed snubbing block, arresting any overrun movement of the spectacle arm. Both the counterweight and the spectacle arm then settle into their normal centered position.

Electrical Characteristics

Figure 7 shows internal wiring of the mechanism. The SD signal has a coil resistance of 250 ohms. It is designed to operate on 10 volts (5 lead cells or equivalent). Minimum current required for proper signal operation is 0.024 amp.

Contact Arrangement

Aspect-checking contacts are directly actuated by the tractive-armatures. Contacts operate as shown in Figure 5. They are wired as shown in Figure 7.